U.S. Department of Transportation Dockets
Docket No. FAA-2000-7909
400 Seventh Street SW
Room Plaza 401
Washington, DC 20590

Subject: Comments to NPRM 00-09, "Improved Flammability Standards for Thermal/Acoustic Insulation Materials Used in Transport Category Airplanes". Docket No. FAA 2000-7909

Gentlemen:

The members of the Aerospace Industries of America, Inc. (AIA) manufacture products subject to the regulatory requirements of 14 CFR Parts 25, 91, 121, and 135, which this NPRM proposes to modify. The AIA has followed the development of these proposals and supports their objectives. The AIA has followed their development and has made many suggestions through the International Aircraft Materials Fire Test Working Group (IAMFTWG). The AIA endorses the IAMFTWG and the FAA's commitment to it.

However, the AIA believes there are problems with both proposals as presented that need to be addressed and resolved prior to any regulatory changes.

Background

Aircraft Design for Thermal/Acoustic Attenuation

Aircraft are subjected to extremes of temperature and noise in operation. Aircraft skin temperatures vary from about -60F to about 160F, and a large amount of engine and aerodynamic noise is produced. For passenger and crew comfort and well being, aircraft design requires that occupied areas be shielded from these extremes. Historically thermal/acoustic insulation has been installed between the aircraft skin and cabin liners, and has consisted primarily of blankets constructed of glass fiber batting in a thin plastic film covering.

Glass fiber batting is able to satisfy both the thermal and acoustic needs at viable weight, geometric volume, and cost. For acoustic reasons, the diameter of glass fibers used in aircraft insulation is very much smaller than that of glass fibers typically used in home and building insulation. Glass fiber batting used in aircraft insulation is essentially a "specialty" product unique for aircraft usage, and no material has been developed which exceeds its combined thermal and acoustic capabilities.

The plastic films used to encapsulate the batting do not perform any thermal or acoustic function; their function is to to keep water out of the batting, and to hold the batting in place. The films used have been predominantly made from polyethylene terephthalate (PET – an example is DuPont's Mylar®). Some used to a lesser extent were made from polyvinyl fluoride (PVF – an example is DuPont's Tedlar®), and others to a still lesser extent were made from polyimide (PI – an example is DuPont's Kapton®).

Although glass fiber blankets have historically been the predominant form of thermal/acoustic insulation, other materials such as foams, felts, etc., have also been used. Further, components other than insulation installed between the fuselage skin and cabin

liners are acoustic attenuators and their contributions are taken into account in designing acceptable cabin sound levels. Example are cabin sidewall and ceiling liners, flooring, and seats.

FAA regulations do not address either the thermal or acoustic effectiveness of insulation; the regulations address only its flammability properties and fire safety. In this NPRM, the FAA proposes to make two changes to these regulations:

1. Replace the current Bunsen burner test with a radiant panel test for all thermal/acoustic insulation to upgrade its resistance to fire propagation.
2. Add a new test requirement on insulation installed along the fuselage skin in the "lower half" of the fuselage to better protect the passenger cabin from burnthrough of a fuel-fed external fire.

The AIA supports the objectives of both. The AIA however believes there are problems affecting both proposals that need to be addressed.

What is Thermal/Acoustic Insulation?

The FAA has used the term "thermal/acoustic insulation" and "thermal/acoustic insulation materials" more or less loosely to refer to insulation blankets or equivalent. However, to avoid future controversy and problems with multiple and conflicting rule interpretations, the AIA believes that it is critical to establish exactly what comprises "thermal/acoustic insulation". The current regulatory requirement is in §25.853 and dates from Amendment 25-32, issued in 1972, and requires "thermal and acoustical insulation and insulation covering" meet the 12-sec vertical Bunsen burner test. Strictly speaking, "thermal and acoustical insulation" logically consists of any component that performs a thermal and/or acoustic attenuating function. The glass fiber batting in traditional blankets performs both a thermal and an acoustic attenuating function, but the plastic film covering the batting performs neither and is not in this sense "insulation"; it is "insulation covering".

Historically the primary materials addressed as "insulation" have been blankets made of glass fiber batting with a plastic film covering, with some amounts of foams, felts, etc. However, other components provide thermal and/or acoustic insulation functions, such as sidewall and ceiling liners, partitions, and carpet and carpet padding. The AIA is very concerned about what components/materials would be affected by the proposals. Examples are:

- Sidewall panels and ceiling panels by design comprise part of the acoustic treatment of the passenger cabin. In a strict interpretation of the fire propagation resistance proposal, they would be considered "insulation" as well as "sidewalls" and "ceilings", and therefore in addition to heat release, smoke release, and Bunsen burner tests would be subjected to the radiant panel test. This is not the FAA's intent of this proposal, which is to address only insulating blankets or equivalent in areas inside the pressure shell but outside the passenger cabin and cargo compartments.
- Since sidewall panels and ceiling panels are acoustically functional by design, in a strict interpretation of the burnthrough resistance proposal, they could be considered as part of the fire barrier. While it does not seem that this is what the FAA has in

mind, including these items as part of the fire barrier certainly appears to meet the objective of the proposal.

- "Layered entities" are sometimes treated for certification in more than one way. The FAA requires that if two entities are glued or mechanically attached to each other ("layered entities"), the test specimen configuration used for flammability compliance testing must include both entities plus whatever is holding them together. Thus, if glass fiber blankets installed between the aircraft skin and sidewalls are glued to or mechanically attached to the sidewalls, the test specimen configuration used to show compliance of the sidewall panel to applicable heat release and smoke release test requirements must incorporate the sidewall panel plus the attached insulation. One interpretation of the fire propagation resistance test requirement could involve this kind of test specimen. The AIA does not believe this is appropriate.

Applicability of Proposed New Requirements

The AIA has concerns involving the applicability of the proposed new requirements. Currently the requirements for "insulation and insulation covering" are in §25.853 *Compartment Interiors* and in §25.855 *Cargo or Baggage Compartments.* The proposed new wording in §25.853 and §25.855 exempts thermal/acoustic insulation from their provisions and places insulation requirements in a newly-created §25.856 *Insulation Materials*. There are three problems with the proposed wording in §25.856:

1. §25.856 as written is not specific to insulation installed in compartment interiors or cargo/baggage compartments, and its provisions would also apply to insulation installed outside the pressurized area, such as engines. The AIA believes that §25.856 should be reworded to exclude application to insulation installed outside the pressurized area.
2. Currently the requirements for "insulation and insulation covering" in §25.853 include an exclusion for "small parts". However, the proposed new wording in §25.856 does not have a provision for small parts. The AIA believes there should be a provision for excluding small parts, and suggests using the same criteria used for heat and smoke release, which is that a part is "small" if it encompasses less than a square foot and there are not several such parts installed in close proximity.
3. The proposed burnthrough requirement in §25.856 that applies to "insulation materials (including the means of fastening the materials to the fuselage) installed in the lower half of the airplane fuselage" is not specific to insulation materials installed against the airplane fuselage. As written it also applies to insulation installed in other locations, such as on air conditioning ducts. The AIA believes that §25.856 should be reworded to apply only to insulation installed against the airplane fuselage.

Resistance to Fire Propagation

General

Current regulatory requirements refer to "insulation and insulation covering", and require that the materials be subjected to the 12-second vertical Bunsen burner test described in

14 CFR Part 25, Appendix F, Part I. This NPRM proposes to replace the current test procedure with a one involving a radiant panel. The AIA supports the objective of this proposal. The AIA however does not believe the proposed pass/fail criteria are viable as stated, and recommends specific changes to resolve that problem.

Test Procedure

Various factors have led to unexpected delays in acquiring and installing the test equipment at AIA members' facilities. Only a very few laboratories have the test equipment, and no round robins have been carried out to explore interlaboratory repeatability. The AIA has concerns about the test procedure because experience with all previous new regulatory flammability test procedures has shown serious problems becoming stable and repeatable.

The test procedure described in the NPRM is a snapshot of the status of the procedure being used by the FAA at a specific point in time. The procedure is still being developed with participation of the IAMFTWG. The AIA supports and participates in the IAMFTWG activities, which are primarily to work to develop test methods to improve interlaboratory repeatability.

Pass/Fail Criteria

The proposed pass/fail criteria are as follows:

1. No flaming beyond 2 inches (51 mm) to the left of the centerline of the point of pilot flame application is allowed.
2. Of the 3 specimens tested, only 1 specimen may have an after flame. That after flame may not exceed 3 seconds.

The first criterion is unclear whether this is a requirement on each test specimen, or a requirement on the average of all specimens tested. It must be an average to be viable. A requirement that no test specimen have flaming beyond 2 inches is not viable, because if any test specimen of a candidate material ever has flaming that exceeds 2 inches without some identifiable cause that justifies that result being excluded, then that single test result fails the material no matter how many specimens are tested or what the results of all the other test specimens are. If enough specimens are tested, experience indicates that sooner or later one will have flaming beyond 2 inches. The AIA recommends that this be clarified to be an average, viz.,

1. The average distance for flaming to the left of the centerline of the point of pilot flame application shall not exceed 2 inches (51 mm) for all specimens tested.

The second criterion must be an average of all specimens tested to be viable. As stated it is not viable, because if any test specimen of a candidate material ever has an after flame time that exceeds 3 seconds without some identifiable cause that justifies that result being excluded, then that single test result fails the material no matter how many specimens are tested or what the results of all the other test specimens are. In fact, after flame times exceeding 3 seconds have already been seen sporadically on test specimens of materials that have "passed". The AIA recommends that this be changed to an average, viz.,

2. The average after flame time following removal of the pilot flame may not exceed 3 seconds for all specimens tested.

Cost

The primary economic impact of this change would come from changing the cover films used for glass fiber blankets. PVF films appear to be the most likely types used. Although there are some PVF cover films now being used that meet the proposed criteria, most cover films in current production are made from PET and do not meet them. These PET films would have to be replaced with PVF films. Changes in blanket geometry would not be required, but it is unclear whether part number changes would be required for configuration management purposes.

The FAA indicated in the NPRM that there are materials now being installed for production aircraft that meet these proposed criteria, and that there would therefore be no added cost for replacement. However, PVF films are more expensive and heavier than PET films, and higher recurring costs for finished blankets estimated at about 14% (about $5,000,000 per year for Boeing Puget Sound airplanes at current production rates) would be involved. If replacement of PET films with PVF films can be done without having to change-part numbers, there would be only minor non-recurring costs and the economic impact would derive from recurring costs. The change to PVF films would result in additional weight from about 30 pounds for a 737 to about 160 pounds for a 747.

If part number changes are required, there will be a substantial non-recurring cost since there are more than 25,000 parts involved. Further, if it is accepted that part numbers must be changed to manage the configuration, then that policy would have to be applied to spare parts also, raising the total number to about 100,000. The cost of changing 25,000 part numbers is approximately $20 million.

Resistance to Burnthrough

General

This NPRM proposes to require that thermal/acoustic insulation, if installed next to the skin in the lower half of the fuselage, be a fire barrier and be installed in a way so that the total installation is resistant to burnthrough from a fire source simulating a post-crash fuel-fed fire. The purpose of this requirement is to better protect the passenger cabin from fire from burnthrough of a post-crash fuel-fed fire, thus providing passengers more time to evacuate the airplane. The AIA supports protecting the passenger cabin from a fuel-fed fire by available and effective means.

The proposal is to apply the fire barrier in the “lower half of the fuselage”. The AIA believes the applicability needs to be more precise since what is in the lower half varies from one airplane to another, and some areas of the lower half of the fuselage, such as cargo compartments where the insulation forms the floor, already have requirements for burnthrough resistance. In past incidents and tests (DOT/FAA/CT-90/10), a primary path for fire to enter the passenger cabin has been through the air return grills. In these events, burnthrough typically has occurred in the “cheek” area, which is the area below the passenger floor but outside the cargo compartment. The cabin ventilation system moves

old cabin air into the cheek area through the air return grills along the bottom of the sidewall panels, and exhausts it through the dump valve. When fire has burned through in the cheek area, it has propagated into the cabin through the air return grills. A fire barrier to protect the cheek area would provide the most benefit to protecting the passenger cabin. Cargo compartments already have liners that are highly fire resistant, so fire burning into a cargo compartment has no path to the passenger cabin.

The FAA proposes to require that the thermal/acoustic insulation be a fire barrier. There is no reason, however, why the fire barrier cannot be some other component. For example, a layer of ceramic fiber paper was found very effective in the oil burner burnthrough test (DOT/FAA/AR-98/52) when it was incorporated in a glass fiber blanket on the outer surface of the glass batting. It is also effective if it is placed outside the blanket against the fuselage skin, which is an attractive concept to address installation requirements involving gaps between blankets, etc. If the ceramic fiber paper was installed independent of the blanket, it would probably be effective as well. However, since the paper does not perform any acoustic or thermal function, it may not be considered part of the "thermal/acoustic insulation" whether it is inside or outside the blanket.

A more appropriate regulatory approach would be to require that the fuselage design in the affected fuselage areas incorporate a fire barrier and leave the actual design to industry. The proposed test method could still be used, with modifications as required to address other components. The FAA could issue an Advisory Circular citing use of thermal/acoustic insulation installations as an acceptable means of compliance to the general requirement.

Mandating that the thermal/acoustic insulation be a fire barrier irrespective of other components creates an awkward situation of not requiring that insulation be installed, but if it is installed requiring that it be burnthrough resistant. The FAA reasoned it is unlikely that operators would side-step compliance by not installing insulation "because of the need to provide a suitable thermal and acoustical environment inside the airplane". However, some short-haul transport category airplanes are routinely operated today without insulation installed below the passenger cabin floor. Acoustic requirements below the passenger cabin floor are lower than above the passenger floor, and thermal requirements are important only for longer duration flights. The operators have found the thermal and acoustic penalties to be acceptable, and remove the blankets for economic and maintenance reasons, although the practice is not endorsed by manufacturers.

If the thermal/acoustic insulation is required to be a fire barrier, the geometry of existing glass fiber blankets is not compatible with probable blanket overlap requirements for installation. The vast majority of affected insulation components, which number more than ten thousand in AIA products, would have to be redesigned. A fire barrier that is not part of the insulation may not require blanket redesign.

The AIA believes that there are additional issues which need to be considered in a discussion of improving fuselage burnthrough resistance and that these issues support the argument for a generalized regulatory requirement rather than the proposed specific design requirement. Some examples are:

- The possible impact of fuselage constructions other than aluminum monocoque on post-crash fuel-fed fire scenarios needs to be explored. All the research done for this NPRM was done on aluminum monocoque, whose skin melts within about a 30-second exposure. This is the predominant construction used today, and will probably remain so for a few more years. However, new structural types are being researched and implemented. Composite structures, which are now used in primary structure in production airplanes, are more resistant than aluminum structures in fire. GLARE, a material comprised of glass fibers in aluminum sheet, is very likely to be incorporated in new fuselage designs in the very near term, and is also more resistant than aluminum in fire. TiGr, a combination of titanium and graphite, is also being considered for new designs, and is essentially resistant to burnthrough in such scenarios.
- Manufacturers have already incorporated burnthrough resistant features in some existing designs. Cabin liners made of phenolic/glass or phenolic/carbon composites, for example, are now used almost exclusively in newly manufactured airplanes. These liners are much more resistant to burnthrough than the aluminum liners formerly used.
- In burnthrough incidents and in large-scale tests, the first entry point for fire into the passenger cabin has been predominantly through the air return grills. A means to seal off this path during a fire could be pursued.

Test Procedure

The burnthrough oil burner test equipment has been installed in one AIA member's facility, and has been used to participate in the round robins. Interlaboratory repeatability of test results experienced to date needs to be improved.

The test procedure described in the NPRM is a snapshot of the status of the procedure being used by the FAA at a specific point in time. The procedure is still being developed with participation of the IAMFTWG. The AIA supports and participates in the IAMFTWG activities, which are primarily to work to develop test methods to improve interlaboratory repeatability.

Pass/Fail Criteria

If burnthrough protection is to be implemented by a fire barrier installed next to the fuselage skin, the pass/fail criteria proposed are suitable.

Cost

The AIA has not made a separate detailed estimate of the cost to comply with this proposal. The FAA estimates that the cost over 20 years will be $103.1 million, or $68.2 million discounted to present value if manufacturers have to make configuration changes, which is certainly the case because current insulation blanket geometry is not compatible with the installation requirements.

Recommendations

The AIA supports the objective of both of these proposals.

Regarding the applicability of these proposed requirements, §25.856 needs to be reworded to exclude insulation installed outside the pressurized area, to exclude insulation comprising small parts, and to exclude insulation installed in the lower half of the fuselage except that installed against the fuselage from the burnthrough requirement.

Regarding the proposal for resistance to fire propagation, the AIA supports the initiative provided the development of the test method continues to involve the IAMFTWG and the pass/fail criteria are changed as follows:

- The average distance for flaming to the left of the centerline of the point of pilot flame application shall not exceed 2 inches (51 mm) for all specimens tested.
- The average after flame time following removal of the pilot flame may not exceed 3 seconds for all specimens tested.

Regarding the proposal for resistance to burnthrough, the AIA believes the FAA approach of mandating a design solution for a fire barrier through regulatory action is inappropriate. A more appropriate approach would be to require that the fuselage design in the affected areas incorporate a fire barrier, and leave the actual design to industry. The FAA could address specific solutions through Advisory Circulars. The AIA recommends the FAA withdraw this part of the proposal and reissue it as a proposed fuselage design requirement.